

*Philip Chizek*  
*Global Marketing & Sales*  
*Fuel Cells & e-drive programs*

**S**

*T Technologies*

## Environmental Vision

**“ In today’s world, solving  
environmental problems is an  
investment, not an expense.”**


**William Clay Ford, Jr.  
Chairman and CEO,  
Ford Motor Company**

# TH!NK Technologies

## Role within Ford's Trustmark

**Global Center of Excellence for design & development of electric drive vehicle propulsion technology**

- Develop Fuel Cell programs for all Trustmark Brands
- Electric Drivetrain for Hybrids
- Support *TH!NK* Mobility battery driven products



The image is a promotional graphic for TH!NK Technologies and Mobility. At the top, the **TH!NK** logo is displayed in white on a black background. Below this, the Ford logo and the **TH!NK** logo are shown on the left, with the website [www.think-technologies.com](http://www.think-technologies.com) on the right. The middle section features five vehicle images with their respective labels: Focus FCEV Hydrogen Fuel Cell, Focus FCEV Methanol Fuel Cell, P2000 Hydrogen Fuel Cell, USPS EV, and Ranger EV. Below this, the website [www.thinkmobility.com](http://www.thinkmobility.com) is shown. The bottom section displays four more vehicle images with their labels: **TH!NK city** Electric Vehicle, **TH!NK neighbor** Low Speed Vehicle, **TH!NK bike** (powered) Folding Electric Bike, and **TH!NK bike** (fuel) Electric Bike. The Ford Motor Company logo is at the bottom left.

**TH!NK**

Ford **TH!NK** [www.think-technologies.com](http://www.think-technologies.com)

Focus FCEV Hydrogen Fuel Cell Focus FCEV Methanol Fuel Cell P2000 Hydrogen Fuel Cell USPS EV Ranger EV

[www.thinkmobility.com](http://www.thinkmobility.com)

**TH!NK city** Electric Vehicle **TH!NK neighbor** Low Speed Vehicle **TH!NK bike** (powered) Folding Electric Bike **TH!NK bike** (fuel) Electric Bike

Ford Motor Company

## **Fuel Cell**

**An energy conversion device that electrochemically converts chemical energy into electrical energy.**

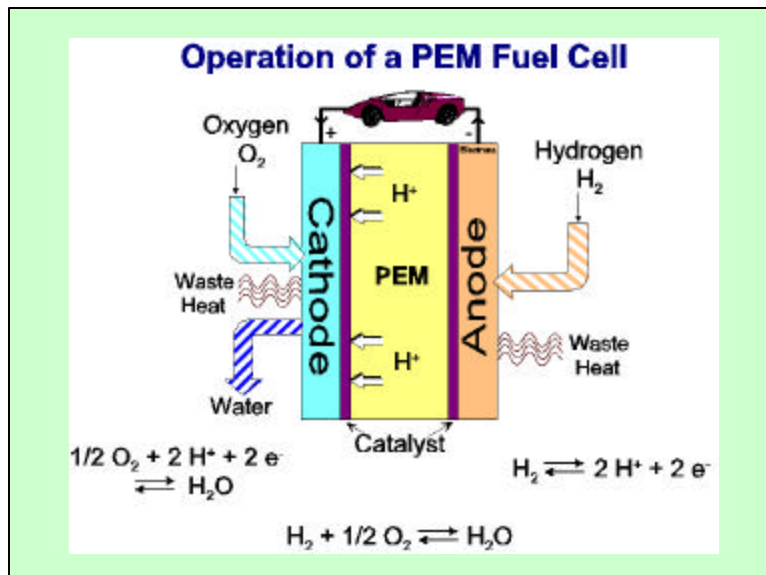
### **Why Investigate Fuel Cells?**

**Fuel cells offer substantial benefits toward improving transportation's impact on health and environment.**

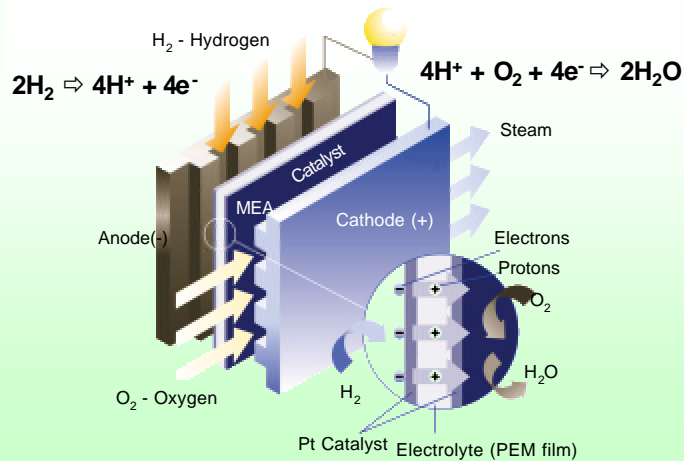
## Fuel Cell Vehicle Potential

- Zero emission vehicle
- 2 - 3 times the fuel economy of conventional internal combustion engines (ICE)
- Comparable performance compared to ICE
- Sustainable Transportation
- Less dependence on imported oil

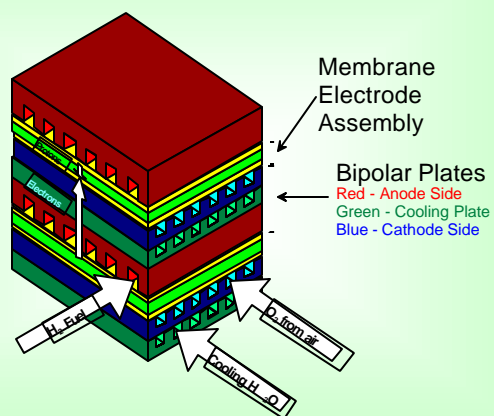
\* using hydrogen fuel



## PEM Fuel Cell Operation

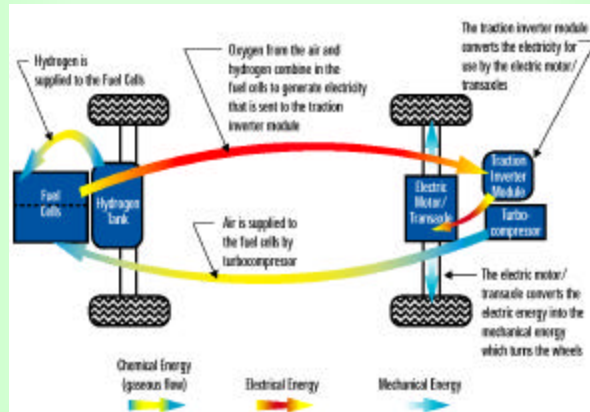


## Typical PEM Fuel Cell Construction



Ian D. Sims, July 1993 - revised, JAA 02/18/99

## Fuel Cell Powered Vehicle



## Fuel Cell Demo Vehicles



1998  
P2000  
FCEV  
Gaseous Hydrogen



2000  
California Demo  
Ford Focus  
Gaseous Hydrogen



2001  
Japan Demo  
Mazda Premacy  
Methanol

## P2000 FCEV

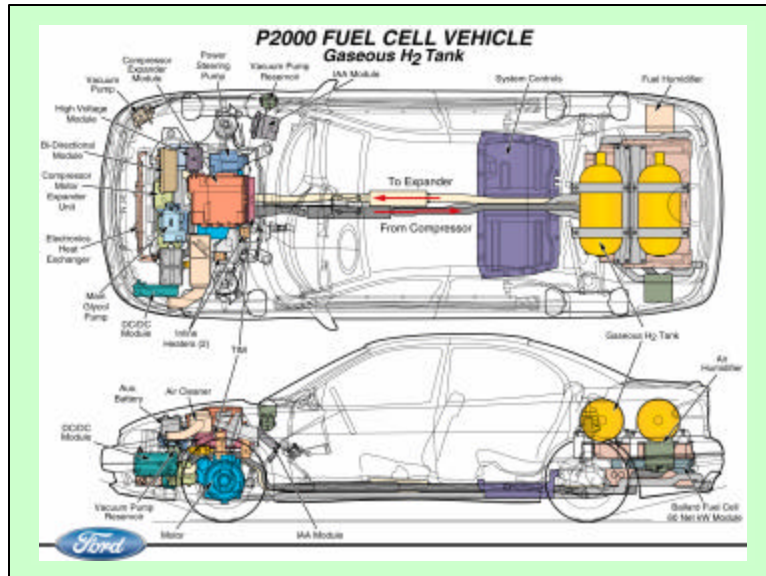
### Features

- Compressed hydrogen
- PEM fuel cell array
- Taurus-size interior
- Lightweight aluminum body and structure
- Driveability of a conventional vehicle



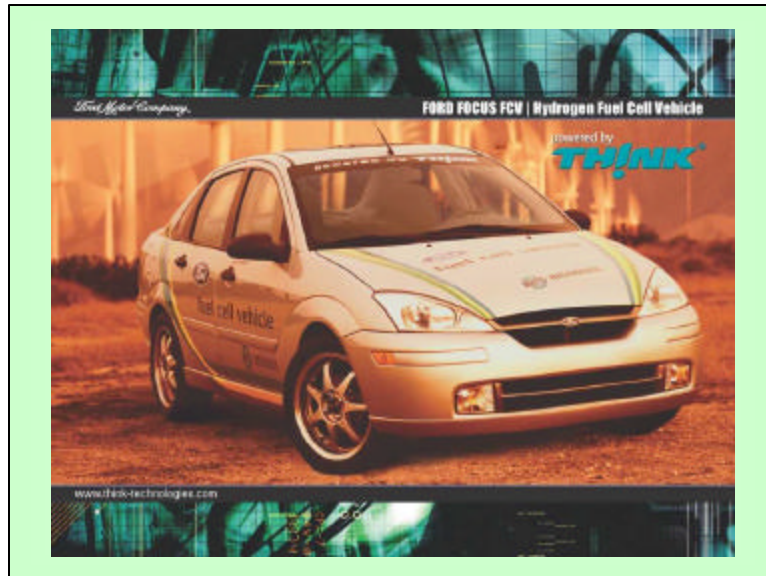
## P2000 FCV Performance Data

<b>Driving Range (EPA 75 )</b>	<b>over 100 miles</b>
<b>Fuel Efficiency (EPA75 / Highway)</b>	<b>58 / 81 miles per gallon of equivalent gasoline</b>
<b>Top Speed</b>	<b>over 80 mph</b>
<b>Acceleration (0 - 30 / 0 - 60 mph)</b>	<b>4.2 / 12.3 sec.</b>





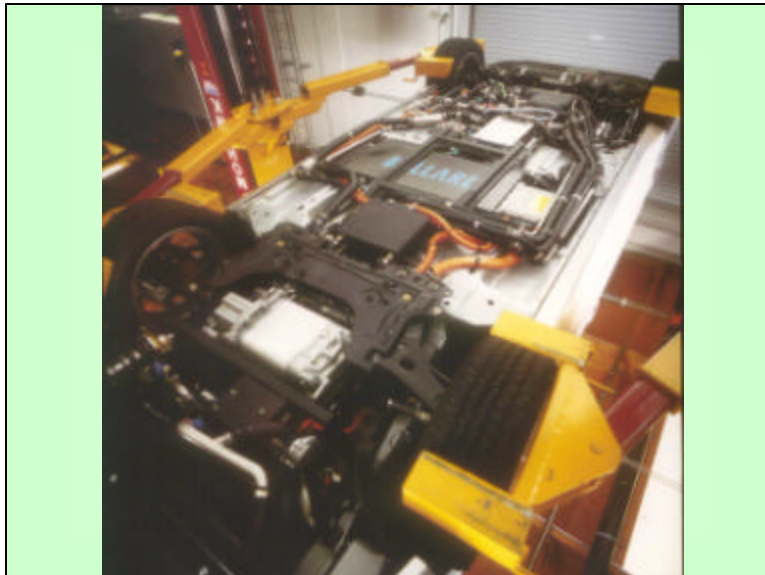
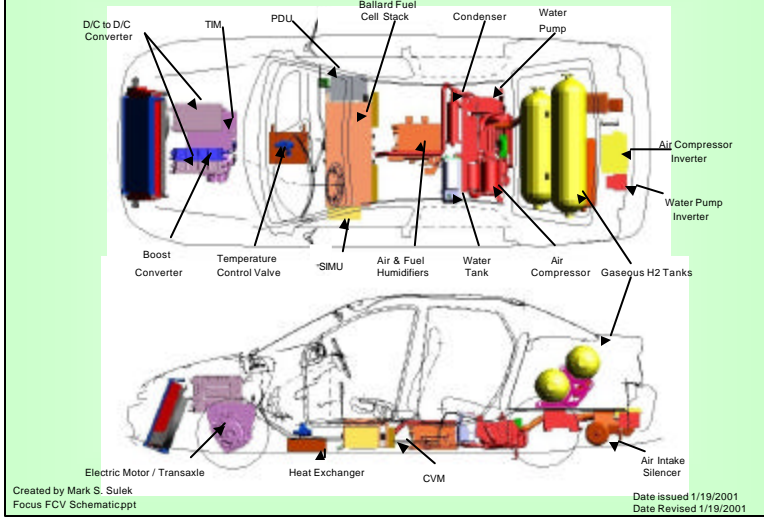




## Focus FCV Performance Data

Driving Range (EPA 75 )	over 100 miles
Fuel Efficiency (EPA75 / Highway)	58 / 81 miles per gallon of equivalent gasoline
Top Speed	over 80 mph
Acceleration (0 - 30 / 0 - 60 mph)	4.2 / 14.3 sec.

### Ford's Focus FCV (Fuel Cell Vehicle)









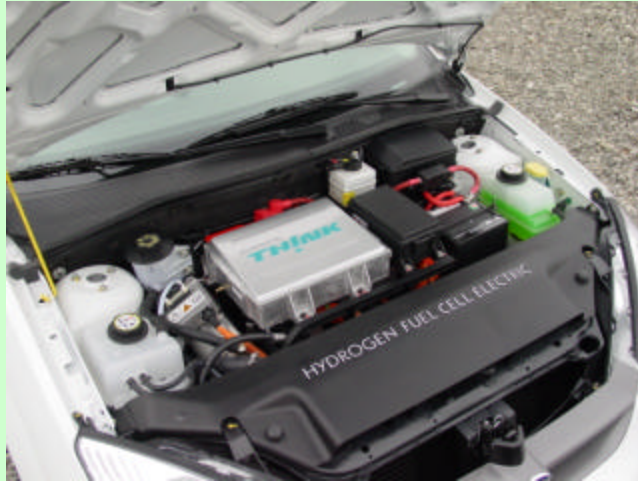
## 2002 Ford Focus, Hybrid Fuel Cell



## Focus Hybrid FCV Performance Data

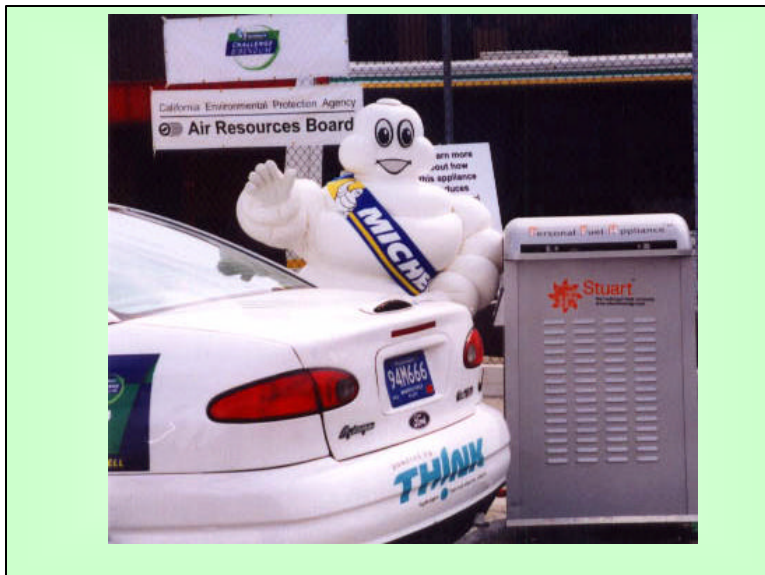
<b>Driving Range (EPA 75 )</b>	<b>160 to 200 miles</b>
<b>Fuel Efficiency (EPA75 / Highway)</b>	<b>58 / 81 miles per gallon of equivalent gasoline</b>
<b>Top Speed</b>	<b>Over 80 mph</b>
<b>Acceleration (0 - 30 / 0 - 60 mph)</b>	<b>3.0 to 4.2 / 10 to 14.0 sec.</b>





## Refueling





# Challenges

## Commercialization Challenges

- Affordable price
- Traffic compatible performance
- 300+ miles range
- Convenient refueling
- Practical payload
- Good ride, handling and low NVH
- Reliable and safe operation
- Rapid start-up

## Commercialization Challenges

### Pros

- High fuel efficiency
- Zero emissions
- High tech image
- Fuel flexibility
- Possible use of renewable energy

### Cons

- Cost premium
- Hydrogen safety perception
- Limited refueling
- Unfamiliar technology
- Codes/Standards
- ICE progress

## The Cost Challenge

The Consumer will not pay a premium for Fuel Cell technology

- Fuel Cell Vehicles must be cost competitive with advanced ICEs and hybrids

## Fuel Cell Alliance Ford/DaimlerChrysler/Ballard

- Develop commercially viable electric powertrain technology for fuel cell and other applications
- Supply world class electric powertrain systems to automotive customers worldwide
- Support high volume, non-automotive markets to expand volume and accelerate progress to commercial viability



Bringing together automakers, energy providers, technology companies and government agencies

## Partnership Members

### Technology Partners

- Ballard Power Systems
- International Fuel Cells
- Daimler Chrysler
- Ford Motor Company
- Honda
- Hyundai
- Nissan
- Volkswagen
- General Motors
- Toyota

### Fuel Partners

- BP
- Shell Hydrogen
- Texaco
- ExxonMobil

### Government Partners

- California Air Resources Board
- California Energy Commission
- South Coast Air Quality Management District
- U.S. Department of Energy
- U.S. Department of Transportation

### Associate Partners

- Air Products and Chemicals, Inc.
- Praxair
- Methanex
- Sunline Transit Agency
- AC Transit Agency
- Hydrogen Burner Technology
- Proton Energy Systems
- Stuart Energy

## Summary and Conclusions

- **PEM fuel cells have enormous potential**
  - Zero emission vehicle
  - Fuel efficient
  - Competitive with ICE performance
- **Our Goal: Transform this potential into a consumer acceptable products.**

## VIP Event Photos

WHQ - Bill Ford, Jr. with Fuel Cell Team



## Educating President Bush about Ford's Fuel Cell Efforts









*P2000 with Canada's Prime Minister Chretien*



**To Learn More**

**[www.think-technologies.com](http://www.think-technologies.com)**